

UNIT TERMINAL OBJECTIVE

- 4-3 At the completion of this unit, the paramedic student will be able to integrate pathophysiological principles and the assessment findings to formulate a field impression and implement the treatment plan for the patient with soft tissue trauma.

COGNITIVE OBJECTIVES

At the completion of this unit, the paramedic student will be able to:

- 4-3.1 Describe the incidence, morbidity, and mortality of soft tissue injuries. (C-1)
- 4-3.2 Describe the layers of the skin, specifically: (C-1)
 - a. Epidermis and dermis (cutaneous)
 - b. Superficial fascia (subcutaneous)
 - c. Deep fascia
- 4-3.3 Identify the major functions of the integumentary system. (C-1)
- 4-3.4 Identify the skin tension lines of the body. (C-1)
- 4-3.5 Predict soft tissue injuries based on mechanism of injury. (C-1)
- 4-3.6 Discuss the pathophysiology of wound healing, including: (C-1)
 - 1. Hemostasis
 - 2. Inflammation phase
 - 3. Epithelialization
 - 4. Neovascularization
 - 5. Collagen synthesis
- 4-3.7 Discuss the pathophysiology of soft tissue injuries. (C-2)
- 4-3.8 Differentiate between the following types of closed soft tissue injuries: (C-3)
 - a. Contusion
 - 2. Hematoma
 - 3. Crush injuries
- 4-3.9 Discuss the assessment findings associated with closed soft tissue injuries. (C-1)
- 4-3.10 Discuss the management of a patient with closed soft tissue injuries. (C-2)
- 4-3.11 Discuss the pathophysiology of open soft tissue injuries. (C-2)
- 4-3.12 Differentiate between the following types of open soft tissue injuries: (C-3)
 - a. Abrasions
 - 2. Lacerations
 - 3. Major arterial lacerations
 - 4. Avulsions
 - 5. Impaled objects
 - 6. Amputations
 - 7. Incisions
 - 8. Crush injuries
 - 9. Blast injuries

- 10. Penetrations/ punctures
- 4-3.13 Discuss the incidence, morbidity, and mortality of blast injuries. (C-1)
- 4-3.14 Predict blast injuries based on mechanism of injury, including: (C-2)
 - a. Primary
 - 2. Secondary
 - 3. Tertiary
- 4-3.15 Discuss types of trauma including: (C-1)
 - a. Blunt
 - 2. Penetrating
 - 3. Barotrauma
 - 4. Burns
- 4-3.16 Discuss the pathophysiology associated with blast injuries. (C-1)
- 4-3.17 Discuss the effects of an explosion within an enclosed space on a patient. (C-1)
- 4-3.18 Discuss the assessment findings associated with blast injuries. (C-1)
- 4-3.19 Identify the need for rapid intervention and transport of the patient with a blast injury. (C-1)
- 4-3.20 Discuss the management of a patient with a blast injury. (C-1)
- 4-3.21 Discuss the incidence, morbidity, and mortality of crush injuries. (C-1)
- 4-3.22 Define the following conditions: (C-1)
 - 1. Crush injury
 - 2. Crush syndrome
 - 3. Compartment syndrome
- 4-3.23 Discuss the mechanisms of injury in a crush injury. (C-1)
- 4-3.24 Discuss the effects of reperfusion and rhabdomyolysis on the body. (C-1)
- 4-3.25 Discuss the assessment findings associated with crush injuries. (C-1)
- 4-3.26 Identify the need for rapid intervention and transport of the patient with a crush injury. (C-1)
- 4-3.27 Discuss the management of a patient with a crush injury. (C-1)
- 4-3.28 Discuss the pathophysiology of hemorrhage associated with soft tissue injuries, including: (C-2)
 - 1. Capillary
 - 2. Venous
 - 3. Arterial

- 4-3.29 Discuss the assessment findings associated with open soft tissue injuries. (C-1)
- 4-3.30 Discuss the assessment of hemorrhage associated with open soft tissue injuries. (C-1)
- 4-3.31 Differentiate between the various management techniques for hemorrhage control of open soft tissue injuries, including: (C-3)
 - a. Direct pressure
 - 2. Elevation
 - 3. Pressure dressing
 - 4. Pressure point
 - 5. Tourniquet application
- 4-3.32 Differentiate between the types of injuries requiring the use of an occlusive versus non-occlusive dressing. (C-3)
- 4-3.33 Identify the need for rapid assessment, intervention and appropriate transport for the patient with a soft tissue injury. (C-2)
- 4-3.34 Discuss the management of the soft tissue injury patient. (C-2)
- 4-3.35 Define and discuss the following: (C-1)
 - a. Dressings
 - 1. Sterile
 - 2. Non-sterile
 - 3. Occlusive
 - 4. Non-occlusive
 - 5. Adherent
 - 6. Non-adherent
 - 7. Absorbent
 - 8. Non-absorbent
 - 9. Wet
 - 10. Dry
 - 2. Bandages
 - 1. Absorbent
 - 2. Non-absorbent
 - 3. Adherent
 - 4. Non-adherent
 - 3. Tourniquet
- 4-3.36 Predict the possible complications of an improperly applied dressing, bandage, or tourniquet. (C-2)
- 4-3.37 Discuss the assessment of wound healing. (C-1)
- 4-3.38 Discuss the management of wound healing. (C-1)
- 4-3.39 Discuss the pathophysiology of wound infection. (C-1)
- 4-3.40 Discuss the assessment of wound infection. (C-1)
- 4-3.41 Discuss the management of wound infection. (C-1)

- 4-3.42 Integrate pathophysiological principles to the assessment of a patient with a soft tissue injury. (C-3)
- 4-3.43 Formulate treatment priorities for patients with soft tissue injuries in conjunction with: (C-3)
 - a. Airway/ face/ neck trauma
 - 2. Thoracic trauma (open/ closed)
 - 3. Abdominal trauma
- 4-3.44 Synthesize assessment findings and patient history information to form a field impression for the patient with soft tissue trauma. (C-3)
- 4-3.45 Develop, execute, and evaluate a treatment plan based on the field impression for the patient with soft tissue trauma. (C-3)

AFFECTIVE OBJECTIVES

At the completion of this unit, the paramedic student will be able to:

- 4-3.46 Defend the rationale explaining why immediate life-threats must take priority over wound closure. (A-3)
- 4-3.47 Defend the management regimens for various soft tissue injuries. (A-3)
- 4-3.48 Defend why immediate life-threatening conditions take priority over soft tissue management. (A-3)
- 4-3.49 Value the importance of a thorough assessment for patients with soft tissue injuries. (A-3)
- 4-3.50 Attend to the feelings that the patient with a soft tissue injury may experience. (A-2)
- 4-3.51 Appreciate the importance of good follow-up care for patients receiving sutures. (A-2)
- 4-3.52 Understand the value of the written report for soft tissue injuries, in the continuum of patient care. (A-2)

PSYCHOMOTOR OBJECTIVES

At the completion of this unit, the paramedic student will be able to:

- 4-3.53 Demonstrate the assessment and management of a patient with signs and symptoms of soft tissue injury, including: (P-2)
 - 1. Contusion
 - 2. Hematoma
 - 3. Crushing
 - 4. Abrasion
 - 5. Laceration
 - 6. Avulsion
 - 7. Amputation

8. Impaled object
9. Penetration/ puncture
10. Blast

DECLARATIVE

- I. Introduction
 - A. Epidemiology
 - 1. Incidence
 - 2. Mortality/ morbidity
 - 3. Risk factors
 - 4. Prevention strategies
 - B. Body substance isolation review
 - 1. Risks from exposure to body substances
 - a. Bloodborne pathogens
 - (1) HIV
 - (2) HBV
 - (3) Other bloodborne pathogens
 - b. Other body substances posing risk
 - 2. Relationship to body substance isolation
 - a. Universal precautions
 - (1) Gloves
 - (2) Hand washing
 - (3) Protective eyewear
 - (4) Masks
 - (5) Gowns
 - (6) Handling and disposal of sharps
 - b. Disposal of contaminated materials
 - C. Anatomy and physiology review
 - 1. Layers
 - a. Cutaneous layer
 - (1) Epidermis
 - (a) Stratum germinativum (Basal Layer)
 - (b) Stratum corneum
 - (2) Dermis
 - (a) Fibroblasts
 - (b) Macrophages
 - (c) Mast cells
 - (d) Lymphocytes
 - (e) Papillary dermis
 - (f) Reticular dermis
 - b. Subcutaneous layer (superficial fascia)
 - (1) Loose connective tissue
 - (2) Fat
 - (a) Insulation
 - (b) Protection from trauma
 - c. Deep fascia

- (1) Thick, dense layer of fibrous tissue
 - (2) Support and protect underlying structures
- 2. Functions
 - a. Protection against mechanical trauma
 - b. Regulation of body temperature
 - c. Sensory function
 - (1) Pain
 - (2) Touch
 - (3) Heat
 - (4) Cold
 - d. Protection against bacterial invasion
 - e. Maintenance of fluid balance
- 3. Skin tension lines
 - a. Static tension
 - (1) Constant force due to taut nature of skin
 - (2) Effects on scar formation
 - (3) Consideration in wound debridement and revision
 - (4) Consideration in foreign body removal
 - b. Dynamic tension
 - (1) Caused by underlying muscle contraction
 - (2) Effects on scar formation
 - (3) Consideration in wound debridement and revision
 - (4) Consideration in foreign body removal
- 4. Process of normal wound healing
 - a. Hemostasis of wound healing
 - (1) Injury causes changes in normal skin anatomy
 - (2) Reflex vasoconstriction for up to 10 minutes
 - (3) Clotting process begins
 - b. Inflammatory phase
 - (1) Role of granulocytes
 - (2) Role of lymphocytes
 - (3) Role of macrophages
 - c. Epithelialization phase
 - (1) Wound healing within 12 hours
 - (2) Healing through re-establishment of skin layers
 - d. Neovascularization
 - (1) Role of new vessel formation
 - (2) Neovascularization as soon as 3 days after, lasting a total of 21 days
 - (3) New vessel formation

- e. Collagen synthesis
 - (1) Role of fibroblasts in collagen synthesis
 - (2) Time factors involved with collagen fibers
 - (3) Process of collagen lysis and wound healing
 - (4) Time table for the healing and tensile strength of wound
- 5. Alteration of wound healing
 - a. Anatomic factors
 - (1) Body region
 - (2) Static skin tension
 - (3) Dynamic skin tension
 - (4) Pigmented skin
 - (5) Oily skin
 - b. Concurrent drug use
 - (1) Corticosteroids
 - (2) NSAID
 - (3) Penicillin
 - (4) Colchicine
 - (5) Anticoagulants
 - (6) Antineoplastic agents
 - c. Medical conditions and diseases
 - (1) Advanced age
 - (2) Severe alcoholism
 - (3) Acute uremia
 - (4) Diabetes
 - (5) Hypoxia
 - (6) Severe anemia
 - (7) PVD
 - (8) Malnutrition
 - (9) Advanced cancer
 - (10) Hepatic failure
 - (11) Cardiovascular disease
 - d. High risk wounds
 - (1) Bites (human and animal)
 - (2) Foreign bodies
 - (3) Wounds contaminated with organic matter
 - (4) Injection wounds
 - (5) Wounds with significant devitalized tissue
 - (6) Crush wounds
 - (7) Any wound in immunocompromised patients
 - (8) Any wound in patients with poor peripheral circulation
- 6. Abnormal scar formation

- a. Keloid
 - (1) Excessive accumulation of scar tissue that extends beyond original wound borders
 - (2) More common in darkly pigmented individuals
 - (3) Most common locations
 - (a) Ears
 - (b) Upper extremities
 - (c) Lower abdomen
 - (d) Sternum
- b. Hypertrophic scar formation
 - (1) Excessive accumulation of scar tissue confined within the original wound borders
 - (2) More common in areas of high tissue stress, such as flexion creases across joints
- c. Wounds requiring closure
 - (1) Cosmetic regions (face, lip, eyebrow, etc.)
 - (2) Gaping wounds
 - (3) Wounds over tension areas
 - (4) Degloving injuries
 - (5) Ring injuries
 - (6) Skin tearing

II. Pathophysiology and assessment of soft tissue injuries

- A. Identification of closed soft tissue injuries
 - 1. Contusion
 - a. Epidermis remains intact
 - b. Cells damaged and blood vessels in dermis are torn
 - c. Swelling and pain typically present - may occur up to 24 to 48 hours later
 - d. Blood accumulation causes ecchymosis
 - 2. Hematoma
 - a. Collection of blood beneath skin
 - b. Larger amount of tissue damage as compared to contusion
 - c. Larger vessels are damaged
 - d. May lose one or more liters of blood in confined space
 - 3. Crush injuries
 - a. Crushing force applied to body area
 - b. Can cause internal organ rupture
 - c. Associated with severe fractures
 - d. Overlying skin may remain intact, but internal bleeding may be severe, with shock

- B. Identification of open soft tissue injuries
 - 1. Abrasions
 - a. Outermost layer of skin is damaged by shearing forces
 - b. Painful injury
 - c. Superficial
 - d. No blood, or very little oozing of blood
 - (1) Contamination should be expected
 - 2. Lacerations
 - a. Break in skin of varying depth
 - b. May be linear (regular) or stellate (irregular)
 - c. Jagged wound ends that bleed freely
 - d. May occur in isolation or together with other types of soft tissue injury
 - e. Caused by forceful impact with a sharp object
 - f. Bleeding may be severe
 - 3. Incisions
 - a. Break in skin of varying depth
 - b. Similar to laceration except wound ends are smooth and even, not jagged
 - c. Tend to heal better than lacerations
 - d. Caused by very sharp objects, such as knife, sharp metal, or scalpel
 - 4. Avulsion
 - a. Flap of skin or tissue torn loose or pulled completely off
 - b. Avulsed tissue may or may not be viable
 - 5. Amputations
 - a. Involves the extremities or other body parts
 - b. Jagged skin and/ or bone edges are typically present at site of amputation
 - c. Massive bleeding may be present or bleeding may be limited
 - d. Three types of amputations
 - (1) Complete
 - (2) Partial
 - (3) Degloving
 - 6. Crush injuries
 - a. Causes of injuries
 - (1) Collapse of masonry or steel structures
 - (a) Earthquakes
 - (b) Tornadoes
 - (c) Construction accidents

- (2) Collapse of earth
 - (a) Mudslides
 - (b) Earthquakes
- (3) Motor vehicle collisions
- (4) Warfare injuries
- (5) Industrial accidents
- (6) Any prolonged compression in a chronic situation
 - (a) Unconscious person lying on an extremity
 - (b) Prolonged application of PASG
 - (c) Improperly applied casts
- b. Crush injuries - definitions
 - (1) Crush injury - injury sustained from a compressive force sufficient to interfere with the normal metabolic function of the involved tissue
 - (2) Crush syndrome - traumatic rhabdomyolysis; "smiling death"
 - (3) Systemic manifestations of crush injuries consisting of rhabdomyolysis, electrolyte and acid-base abnormalities, hypovolemia (shock), and acute renal failure
 - (4) Compartment syndrome - local manifestations of muscle ischemia resulting from compressive forces on a closed space
- c. Pathophysiology of crush syndrome
 - (1) Damage to soft tissue and internal organs
 - (2) May cause painful, swollen, deformed extremities
 - (3) External bleeding may be minimal or absent
 - (4) Internal bleeding may be severe
 - (5) Reperfusion phenomenon - systemic effects and even microvascular injury occur after the affected tissue is reperfused
 - (6) Oxygen free radicals
 - (7) Xanthine oxidase - xanthine oxidase requires two substrates - hypoxanthine and oxygen on reperfusion; oxygen is supplied so xanthine oxidase uses oxygen as an electron acceptor generating the oxygen free radical - oxygen superoxide
 - (8) Lipid peroxidation - pressure stretch myopathy

- (9) High intracellular calcium levels
- d. Rhabdomyolysis
 - (1) Destruction of muscle
 - (2) Influx from extracellular fluid into muscle cells
 - (a) Water
 - (b) NaCl
 - (c) Ca⁺⁺
 - (3) Eflux from muscle to extracellular fluid
 - (a) K⁺
 - (b) Purines from disintegrating cell nuclei
 - (c) Phosphate
 - (d) Lactic acid
 - (e) Myoglobin
 - (f) Thromboplastin
 - (g) Creatine kinase & creatinine
 - (4) Consequences - all contribute to development of renal failure
 - (a) Hypovolemia - adds to cardiotoxicity
 - (b) Hypocalcemia - adds to cardiotoxicity
 - (c) Hyperkalemia - adds to cardiotoxicity
 - (d) Hyperuricemia
 - (e) Hyperphosphatemia
 - (f) Metabolic acidosis
 - (g) Possible DIC
 - (h) Increased levels of serum creatine and creatinine
 - e. Pathophysiology of compartment syndrome
 - (1) Tissue pressure rises above capillary hydrostatic pressure resulting in ischemia to muscle
 - (2) Edema of muscle cells develop
 - (3) Prolonged ischemia (> 6 to 8 hours) leads to tissue hypoxia and anoxia, and ultimately cell death
 - (4) Direct soft tissue trauma adds to the edema and ischemia
 - f. Renal failure pathogenesis
 - (1) Hypovolemia
 - (2) Obstructed renal tubules by casts
 - (3) Nephrotoxic agents
 - (4) Other factors
 - g. Crush injury clinical presentation

- (1) General
 - (a) Alert to unresponsive
 - (b) Affected limb may appear almost normal
 - (2) Local signs and symptoms
 - (a) Flaccid paralysis and sensory loss that are unrelated to peripheral nerve distribution
 - (b) May mimic spinal cord injury
 - (c) Early - rigor of the joint distal to the involved muscles, wooden texture of the affected skin and muscles, and loss of voluntary muscle contraction
 - (d) Varying combinations of pain, swelling, sensory changes, weakness, and pain on passive stretching of muscles
 - (e) May have pulses present and warm skin
 - (3) Compartment syndrome
 - (a) Pain
 - (b) Paresthesia
 - (c) Paresis
 - (d) Pressure
 - (e) Passive stretch pain
 - (f) Pulselessness
7. Blast injuries
- a. Causes of blast injuries
 - (1) Natural gas or gasoline explosions
 - (2) Firework explosions
 - (3) Dust within a grain elevator
 - (4) Terrorism (bombs)
 - b. Primary injuries
 - (1) Initial air blast
 - (2) Compression injuries to air filled organs
 - (a) Ruptured ear drum
 - (b) Sinuses
 - (c) Lungs
 - (d) Stomach
 - (e) Intestines
 - c. Secondary injuries due to flying debris striking victim
 - d. Tertiary injuries
 - (1) Victim is thrown from the blast and strikes an object
 - (2) All can lead to superficial and deep internal

- injuries
- 8. Punctures/ penetrations
 - a. Caused by a foreign object that enters the body
 - b. Bleeding is minimal or absent if extremity injury
 - c. Bleeding may be severe if abdominal or thoracic injury
 - d. Underlying damage can be extensive
 - (1) Thoracic
 - (a) Simple pneumothorax
 - (b) Open pneumothorax
 - (c) Tension pneumothorax
 - (d) Hemothorax
 - (e) Pericardial tamponade
 - (f) Penetrating heart wound
 - (g) Rupture of esophagus
 - (h) Rupture of aorta
 - (i) Rupture of diaphragm
 - (j) Rupture of mainstem bronchus
 - (2) Abdominal
 - (a) Solid organ damage
 - (b) Hollow organ damage
 - (c) Peritonitis
 - i) Bacterial
 - ii) Chemical
 - (d) Evisceration
 - e. Increased risk of infection/ complications
- 9. Impaled objects
 - a. Specific type of puncture wound
 - b. Instrument that caused injury remains impacted in wound
- 10. Major arterial lacerations
 - a. Any of these injuries can involve major arterial lacerations
 - b. Bleeding often will be severe
 - c. Spurting, bright red blood flow
 - d. Artery may spasm which may decrease blood flow
 - e. Can result in shock and death if severe enough blood loss

III. Management principles for soft tissue injuries

- A. Treatment priorities
 - 1. Emphasize scene survey to protect yourself and crew
 - a. Have the police ruled out the presence of another

- bomb or device?
 - b. Have the police apprehended the perpetrator?
- 2. Treat for hypoperfusion (shock)
- 3. Consider the power of the explosion
- 4. Internal and external injuries are possible (refer to specific units on specific injuries encountered)
- 5. Be aware of possibility of multiple trauma
- 6. Treatment priorities for patient with a soft tissue injury
 - a. Treatment of life-threatening injury should occur prior to isolated soft tissue trauma
 - (1) Life-threatening airway deficit
 - (2) Life-threatening breathing deficit
 - (3) Life-threatening circulatory deficit
- 7. Methods of hemorrhage control based on injury severity
 - a. Direct pressure
 - (1) General description
 - (a) Quickest/ efficient means
 - (2) Pressure applied directly to wound
 - (a) Dressing and gloved hand
 - (b) Gloved hand
 - (3) Physiology of intervention
 - (a) Limit additional significant blood loss
 - (b) Promote localized clotting
 - (4) Indications
 - (a) Mild hemorrhage
 - (b) Profuse hemorrhage
 - (5) Contraindications - none
 - (6) Assessment of intervention
 - (a) Positive hemorrhage control
 - (b) Prevention of additional significant blood loss
 - (7) Considerations
 - (a) Never remove dressing once in place
 - i) Restart bleed
 - ii) Additional injury
 - (b) Positive hemorrhage control
 - i) Secure in place with bandage
 - (c) Negative hemorrhage control
 - i) Continue direct pressure
 - ii) Apply additional dressing
 - iii) Elevation of extremity with direct pressure

- b. Elevation
 - (1) General description
 - (a) Used concurrent with direct pressure
 - (b) Extremity involvement only
 - (c) Elevation of extremity
 - (2) Physiology of intervention
 - (a) Wound above level of heart
 - (b) Gravity decreases blood pressure in extremity
 - (c) Slow hemorrhage
 - (d) Promote localized clotting
 - (3) Indications
 - (a) Control of hemorrhage
 - (b) Failure of direct pressure to control hemorrhage
 - (4) Contraindications
 - (a) Possible musculoskeletal injury to involved extremity
 - (b) Object impaled in involved extremity
 - (c) Possible spinal injury
 - (5) Assessment of intervention
 - (a) Positive hemorrhage control
 - (b) Prevention of additional significant blood loss
 - (6) Considerations
 - (a) Positive control - continue elevation
 - (b) Negative control
 - i) Continue elevation
 - ii) Consider pressure dressing
- c. Pressure dressing
 - (1) General description
 - (a) Dressing firmly wrapped with self adhering roller bandage
 - (b) Continuous mechanical pressure
 - i) Over injury site
 - ii) Above injury site
 - iii) Below injury site
 - (2) Physiology of intervention
 - (a) Limit additional significant blood loss with continuous pressure
 - (b) Promote localized clotting
 - (3) Indications
 - (a) Hemorrhage control

- (b) Failure of other methods to control hemorrhage
 - i) Direct pressure
 - ii) Elevation
 - (4) Contraindications - none
 - (5) Assessment of intervention
 - (a) Positive control of hemorrhage
 - (b) Prevent additional significant blood loss
 - (6) Considerations
 - (a) Check distal pulse after application
 - i) Positive pulse - leave in place
 - ii) Negative pulse - adjust to establish circulation
 - iii) Some arterial bleeds will stop circulation needed for pulse
 - (b) Certain body regions not conducive to direct pressure
 - (c) If bleeding continues adjust with more pressure
- d. Pressure points
 - (1) General description
 - (a) Site where main artery lies near surface
 - (b) Direct compression applied to site
 - i) Brachial artery
 - ii) Femoral artery
 - (2) Physiology of intervention
 - (a) Decrease blood flow to extremity
 - (b) Limit additional significant blood loss
 - (c) Promote localized clotting
 - (3) Indications
 - (a) Need for hemorrhage control
 - (b) Failure of other methods of hemorrhage control
 - i) Direct pressure
 - ii) Elevation
 - iii) Pressure dressings
 - (4) Contraindications - none
 - (5) Assessment of intervention
 - (a) Positive hemorrhage control
 - (b) Prevention of additional significant blood loss
 - (6) Considerations

- (a) Skill needed to locate pressure points
 - (b) Distal wounds difficult to control with pressure points
 - (c) Proper application
 - i) Considerable force needed
 - ii) Loss of distal pulses
- e. Tourniquet application
 - (1) General description
 - (a) Last resort
 - (b) Tourniquet placed between heart and wound
 - (c) Tourniquet placed within 2" of wound
 - (2) Physiology of intervention
 - (a) Restriction of blood flow to and from extremity
 - (b) Prevent additional significant blood loss
 - (c) Promote localized clotting
 - (3) Indications
 - (a) Control of profuse hemorrhage
 - (b) Last resort after failure of other methods
 - i) Direct pressure
 - ii) Elevation
 - iii) Pressure dressings
 - iv) Pressure points
 - (4) Contraindications - bleeding controllable by other methods
 - (5) Assessment of intervention
 - (a) Positive control of hemorrhage
 - (b) Prevention of additional significant blood loss
 - (6) Considerations
 - (a) Last resort technique
 - (b) Used only on wounds to extremities
 - (c) Never apply directly to knee or elbow
 - (d) Once in place never loosen
 - i) Emboli
 - ii) Restart bleed
 - iii) Tourniquet shock
 - (e) Never use wire/ string/ rope

IV. Review of bandaging and dressing material used in conjunction

with soft tissue trauma

- A. Dressings
 - 1. Sterile
 - a. Has gone through process to eliminate bacteria from dressing material
 - b. Used when infection is a concern
 - 2. Non-sterile
 - a. Has not gone through process of sterilization
 - b. Used when infection is not a concern
 - 3. Occlusive
 - a. Does not allow passage of air through dressing
 - b. Useful for wounds involving thorax and major vessels
 - (1) Negative pressure may cause air to enter thorax or vessel
 - (2) Occlusive dressing may prevent pneumothorax and air embolism
 - (3) Be aware of the possibility of developing tension pneumothorax
 - 4. Non-occlusive
 - a. Allows air to pass through dressing
 - b. Useful for most standard open soft tissue injuries
 - 5. Adherent
 - a. Dressing may adhere to wound surface by incorporating wound exudate into dressing mesh
 - b. May assist in controlling acute bleeding
 - 6. Non-adherent
 - a. Allows passage of wound exudate so that dressing will not adhere to wound surface
 - b. Will not damage surface of wound when removed
 - c. Used after wound closure
- B. Complications of improperly applied dressings
 - 1. Hemodynamic
 - a. Hemorrhage
 - b. Exsanguination
 - c. Ischemia
 - 2. Structural - immediate and distal
 - a. Vessels
 - b. Nerves
 - c. Tendons
 - d. Muscles
 - e. Integument/ tissue
 - f. Organ

- 3. Patient discomfort
- C. Basic concepts of open wound dressing
 - 1. Assessment
 - a. Cleansing
 - b. Irrigation
 - c. Debridement
 - d. Definitive care as appropriate
 - 2. Non-adherent based dressing
 - a. Function/ description
 - b. Indications
 - c. Contraindications
 - d. Considerations
 - e. Technique
 - (1) Location
 - (2) Application/ implementation
 - 3. Absorbent gauze sponges
 - a. Function/ description
 - b. Indications
 - c. Contraindications
 - d. Considerations
 - e. Technique
 - (1) Location
 - (2) Application/ implementation
 - 4. Gauze wrappings
 - a. Function/ description
 - b. Indications
 - c. Contraindications
 - d. Considerations
 - e. Technique
 - (1) Location
 - (2) Application/ implementation
 - 5. Taping
 - a. Function/ description
 - b. Indications
 - c. Contraindications
 - d. Considerations
 - e. Technique
 - (1) Location
 - (2) Application/ implementation
- V. Management of specific soft tissue injuries not requiring closure
 - A. Dressing and bandaging specific soft tissue injuries
 - 1. General principles

- a. Dressing application
 - b. Antibacterial ointment
 - c. Immobilization
 - d. Bandaging
- 2. Injury location
 - a. Scalp dressings
 - b. Facial dressings
 - c. Ear or mastoid dressings
 - d. Neck dressings
 - e. Shoulder dressings
 - f. Truncal dressings
 - g. Groin, hip, and upper dressings
 - h. Hand and finger dressings
 - i. Elbow and knee dressings
 - j. Ankle, knee, and foot dressings
- 3. Open wounds that should be dressed, bandaged and then transported for further evaluation
 - a. Wound with neural compromise
 - b. Wound with vascular compromise
 - c. Wound with muscular compromise
 - d. Wound with tendon/ ligament compromise
 - e. Wound with heavy contamination
 - f. Wound with cosmetic complications
 - g. Wound with foreign body complication
- 4. Any other soft tissue trauma can be dressed and bandaged
 - a. Consider transport versus patient discharge on-scene
- B. Evaluation
 - 1. Overview
 - a. Treat and release
 - b. Treat and refer
 - c. Treat and transport
 - 2. Tetanus vaccine
 - a. Overview
 - b. Tetanus vaccine preparation
 - c. Immunization recommendations
 - d. Allergic/ hypersensitive reactions
 - 3. Patient instructions
 - a. Verbal
 - (1) Overview of written
 - (2) Patient counseling
 - b. Written

- (1) Protection and care of wound area
 - (2) Dressing change and follow-up
 - (3) Wound cleansing recommendations
 - (4) Signs of wound infection
- C. Potential and seriousness of wound infection
 - 1. Description
 - a. Common complication
 - b. Serious complication
 - c. Goal
 - (1) Prevent from infection
 - (2) Protect from infection
 - 2. Mechanism
 - a. Interruption in stratum corneum
 - b. Non sterile external environment
 - c. Integumentary microflora
 - 3. Risk factors
 - a. Wound characteristics
 - b. Wound mechanism
 - c. Technical elements
 - d. General patient condition
 - 4. Complication of wound infection
 - a. General patient recovery
 - b. Localized
 - c. Systemic
 - d. Ancillary conditions
- D. Wound infection causal factors
 - 1. Time
 - a. Cleansing
 - b. Repair
 - 2. Mechanism
 - 3. Location
 - 4. Severity
 - a. Complications
 - b. Tissue damage
 - 5. Contamination
 - 6. Preparation
 - 7. Cleansing
 - 8. Technique of repair
 - 9. General patient condition

- VI. Special considerations regarding soft tissue injuries
- A. Treatment priorities for patients with soft tissue injuries in conjunction with other life-threatening injuries

1. Assess for and treat any existing critical injuries to
 - a. Airway
 - (1) Obstructed airway
 - (2) Concurrent immobilization of spine
 - b. Breathing
 - (1) Inadequate breathing
 - c. Circulation
 - (1) Hypoperfusion
 - (2) Hemorrhage
2. Life-threatening injuries are managed prior to isolated soft tissue trauma
3. Institute appropriate emergency medical care for life-threat
 - a. Life-threatening airway trauma
 - b. Life-threatening head trauma
 - c. Life-threatening thoracic trauma
 - d. Life-threatening abdominal trauma
- B. Emergency medical care of patients with penetrating impalations, chest, and abdominal injuries
 1. Penetrating chest injury
 2. Open wound to the abdomen
 3. Impaled object
 - a. Assessment
 - (1) Location
 - (2) Complications
 - b. Treatment
 - (1) Stabilization
- C. Treatment priorities for patients with amputations and avulsion
 1. Avulsion
 - a. Assessment
 - b. Emergency care of avulsion
 - (1) Airway, ventilation, and circulation
 - (2) Stabilize affected area
 - (3) Dress and bandage wound appropriately
 - (4) Package avulsed area, if complete avulsion, for transport
 - (5) Immediate and safe transport to appropriate facility
 2. Amputations
 - a. Assessment
 - b. Emergency care of amputations
 - (1) Airway, ventilation, and circulation

- (2) Stabilize injured area
 - (3) Do not complete partial amputations
 - (4) Dress and bandage wound appropriately
 - (5) Package amputated body part for transport
 - (6) Immediate and safe transport to appropriate facility
- 3. Crush injuries
 - a. Treatment should be started before the patient arrives in the ED
 - b. Goals
 - (1) Prevent sudden death
 - (2) Prevent renal failure
 - (3) Salvage limbs
 - (4) Institute as early as possible (in the field before the patient is extricated)
 - (5) ABCs as always
 - c. Fluid therapy for hypovolemia
 - (1) Consider bolus of 1-1.5 liters
 - (2) Up to 12 liters may be needed in the first 24 hours
 - d. Alkalinization of the urine
 - (1) Consider adding sodium bicarbonate to IV fluid at one amp per liter to start
 - (2) The goal is to maintain urine Ph > 6.5
 - (3) Controls hyperkalemia and acidosis to prevent acute myoglobinuria renal failure (changes the structure of myoglobin so it passes through the renal tubules)
 - (4) If done in the emergency department, irrelevant to out-of-hospital
 - e. Maintain urine output
 - (1) Goal of diuresis of at least 300 cc per hour
 - (2) Consider Mannitol (10 g or 20% solution to each liter of IV fluid)
 - (3) Loop diuretics such as Lasix are not recommended as they may acidify the urine
 - (4) The "ideal fluid" for crush injury is D5 1/2 normal saline with one amp sodium bicarbonate and 10 g or 20% solution of mannitol
 - (5) Treats hypovolemia
 - (6) Corrects acidosis
 - (7) Treats hyperkalemia, thus preventing sudden cardiac dysrhythmias

- (8) Prevents renal failure
- f. Further treatment of hyperkalemia
 - (1) Forced alkaline diuresis may be adequate
 - (2) CaCl is not indicated unless there is a danger of hyperkalemia dysrhythmia
 - (3) Consider insulin/ glucose for severe hyperkalemia (25cc D50W followed by 10 units regular insulin IV)
- g. Other considerations for management - physician may come to the scene prior to extrication
 - (1) Amiloride
 - (a) K⁺ sparing diuretic
 - (b) Inhibits Na-Ca exchange - protection against "Ca⁺⁺paradox"
 - (c) Administer before reperfusion - before crushed limb is extricated
 - i) Free radical scavengers
 - (d) Superoxide dismutase (superoxide-anion scavenger)
 - (2) Catalase (H₂O₂ ----> H₂O and O₂)
 - (3) Mannitol - scavenges hydroxyl free radicals
 - (4) Allopurinol (xanthine oxidase inhibitor)
 - (a) May prevent reperfusion induced injury in ischemic skeletal muscle and organs such as the kidneys
 - (b) Would have to administer before extrication or as soon as possible afterwards
 - (5) Hospital use of hemodialysis
 - (a) Role in patient who ultimately develops renal failure
 - (b) Can prevent permanent renal damage in patient who is not septic
 - (c) Prevention is the key - delays in IV fluid therapy leads to acute renal failure
- 4. Local injury treatment is controversial
- 5. Closed crush injury
 - a. Use of a tourniquet prior to release of crushed limb may be beneficial
 - b. Compartment syndrome
 - (1) If intracompartmental pressure > 40mm Hg or > diastolic pressure - 30 mm Hg, fasciotomy is

- recommended by many if accompanied by clinical signs and symptoms
 - (2) Concern of increasing tissue necrosis requiring disfiguring debridement and increased risk of sepsis in those injuries older than 8 hours old
 - (3) Early fasciotomy can preserve limb, avoid Volkmann's contracture and preserve cutaneous sensation
 - (4) Medical direction may consider a field fasciotomy
- 6. Open crush injuries
 - a. Wound care required - thorough cleansing, debridement, prophylactic antibiotics, administration of tetanus prophylaxis
 - b. ED surgical consultation
- 7. Amputation
 - a. Field - increased risk of infection/ sepsis, but may be necessary for extrication
 - b. In-hospital - for severely injured limb
- 8. Hyperbaric oxygen treatment
 - a. Shown to decrease tissue necrosis
 - b. Can inhibit lipid peroxidation from oxygen free radicals (via increased levels of superoxide dismutase)
 - c. Decreases muscle edema
 - d. Most useful if done early
- D. Documentation/ record keeping for patients with soft tissue trauma
 - 1. Document patency of airway, ventilation, and circulation and any interventions administered
 - 2. Document patient assessment thoroughly
 - 3. Document general description of wound as to size, location, depth, associated complications
 - a. Neurovascular status
 - b. Joint injury
 - c. Infection
 - 4. Document past medical history, medications, and allergies to medications
 - 5. Document all treatment/ interventions rendered
 - 6. Document patient's response(s) to treatment rendered
 - 7. Document patient's understanding of procedure